MASS. TC60.2: D78

V

UMASS/AMHERST

312066 0278 1265 3

GOVERNMENT DOCUMENTS
COLLECTION

SEP 27 1990

University of Massachusetts
Depository Copy

DRAFT POLICY FOR A PILOT

TYPE II NOISE BARRIER PROGRAM

FOR THE

MASSACHUSETTS TURNPIKE AUTHORITY

MAY 1990

nw

TABLE OF CONTENTS

Page

1.0 Introduction 1

1.1 Program Development 1
1.2 Public Input 2

2.0 Discussion of Guidelines and Criteria Necessary for the Development of a Pilot Type II Noise Abatement Program 3

2.1 23CFR772 3
2.2 Representative State Noise Abatement Policies and Guidelines 3
2.3 Role of Local Governments and Officials 7

3.0 Formation of a Type II Noise Abatement Policy 8

3.1 Eligibility Requirements 8
3.2 Factors Involved in the Development of a Priority Ranking System 8

4.0 Scope of Work & Cost Estimate for Development of the Final Priority List 13

4.1 Scope of Work 13
4.2 Cost Estimate 14

5.0 Considerations Related to Design 15

5.1 Design and Materials 15
5.2 Aesthetics 18
5.3 Maintenance 20
5.4 Environmental Impacts 20
5.5 Scope of Work for Design Services 21

Sources 22

LIST OF TABLES

Table		Page
1	Federal Highway Administration Noise Abatement Criteria	4
2	Representative State Noise Abatement Policies and Guidelines for Type I and Type II Projects	5
3	Noise Abatement Policies of Other Toll Road Authorities	7
4	Various Type and Surface Treatments of Noise Barrier Materials	19

LIST OF FIGURES

Figure		
1	Alternate Noise Barrier Locations Within Right-of-Way	16
2	Standard Noise Barrier Materials in use Along Existing Highway	17

1.0 INTRODUCTION

In response to the increasing concern over existing noise levels experienced by individuals and communities adjacent to the Massachusetts Turnpike, the Massachusetts Turnpike Authority requested that a study be prepared that identifies what is required to facilitate the implementation of a pilot retrofit noise barrier program. The dual purposes of such a program are: 1) to detail a scientific and equitable means for selecting sites that would be eligible for noise abatement, and 2) to provide actual noise abatement from Turnpike traffic noise to these eligible sites based upon appropriate design considerations.

The focus of this report is on the development and implementation of a Type II noise abatement program. The Federal Highway Administration (FHWA) defines two types of projects for which noise abatement studies are conducted (23CFR772). Type I projects refer to noise abatement associated with the construction of a new highway, or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes. Type II projects refer to providing noise abatement on an existing highway such as the Massachusetts Turnpike.

1.1 Program Development

The objective of this report is to provide sufficient background information for the Authority to establish policy procedures for a pilot Type II program. The material presented relates primarily to what information and processes would be required in order to develop a pilot noise abatement program that would be appropriate to use where needed at specific locations along the Turnpike. This report represents step 1 of a six step process that would lead to the implementation of the Authority's pilot noise abatement program:

- Step 1: Establish a policy for a pilot Type II program for noise abatement implementation;
- Step 2: Identify and tabulate eligible noise sensitive land uses within 500 feet of the Turnpike shoulder;
- Step 3: Compute Leq(h) noise levels at the right-of-way (r.o.w.) property line adjacent to the above noise-sensitive land uses. Identify significantly impacted sites;
- Step 4: Assess the acoustical feasibility of noise barriers at the impacted sites. Determine necessary barrier dimensions that would provide significant insertion loss (appreciable noise reduction) to adjacent land uses;
- Step 5: Establish and implement a system of prioritizing eligible sites;
- Step 6: Implement pilot noise abatement measures in accordance with available funding.

Digitized by the Internet Archive
in 2015

https://archive.org/details/draftpolicyforpi00mass

This report presents draft policy procedures, for Turnpike Authority consideration, to identify eligible noise impacted areas. The report also presents a discussion of the various factors important to the development of a method that prioritizes eligible sites for possible retrofit noise barriers. The report also presents considerations related to design and project implementation. Prior to finalizing this first step, the Authority will seek the advice of a professional acoustical consultant and consider comments and recommendations from the general public.

In Steps 2 and 3, the areas to be evaluated for noise abatement would be recommended by the Authority's acoustical consultant. The areas where noise barriers are determined to be feasible, reasonable, and cost-effective to implement would then be recommended in Step 4 by the acoustical consultant. In Step 5, the acoustical consultant would develop and recommend to the Authority an equitable procedure for establishing site priorities and would rank each eligible site according to this procedure. In Step 6, final design would be performed and implementation initiated, based on the acoustical consultant's recommendations and approval by the Authority.

1.2 Public Input

Before finalizing this report and adopting a pilot Type II Noise Abatement Program, the Turnpike Authority will solicit public input on this draft report and the eligibility policy established herein. The draft report will be distributed to officials of the municipalities through which the Turnpike passes and to neighborhood groups that are concerned about Turnpike noise. This will allow affected citizens to voice those issues that are important to them.

During the design phase of the priority noise barriers, community meetings would be held so that residents adjacent to the Turnpike would have a forum in which to participate in the design process. This process is further discussed in Section 5.1 of this report.

2.0 DISCUSSION OF GUIDELINES AND CRITERIA NECESSARY FOR THE DEVELOPMENT OF A PILOT TYPE II NOISE ABATEMENT PROGRAM

The guidelines and criteria discussed in this section of the report for the development of a pilot Type II program take into consideration the (FHWA) noise analysis and abatement procedures found in Title 23 of the Code of Federal Regulations, Part 772 (23CFR772), representative state noise and toll road authority abatement policies and guidelines for Type I and Type II projects, and the role of local governments and officials in preventing future traffic noise impacts on currently undeveloped lands within whose jurisdiction the Turnpike is located.

2.1 23CFR772

The stated purpose of 23CFR772 is to provide procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria (Table 1), and to establish requirements for information to be given to local officials for use in land use planning. The development and implementation of Type II projects are not mandatory requirements of 23CFR772 and are, therefore, not required under that directive.

Although primarily applicable to Type I projects, 23CFR772 provides a basic framework which can be considered when developing a Type II program. FHWA noise abatement criteria and noise prediction/attenuation models are used by those states that have adopted Type II noise abatement programs. However, each state develops its own specific criteria for establishing reasonableness, feasibility, and cost-effectiveness for noise abatement under a Type II program. Each state also determines site eligibility for possible retrofit noise abatement.

2.2 Representative State Noise Abatement Policies and Guidelines

Representative policies and guidelines for Type I and Type II projects among eleven states are presented in Table 2. As of this writing, no other states have active Type II policies. Guidelines for Type I projects have been presented in addition to those for Type II programs in order to provide a better comparison of what other states are doing in the area of noise abatement, since most states have not yet instituted a formal Type II program from which additional comparisons could be made. As shown in Table 2, the formal Type II policies that have been adopted by New Jersey, Maryland, Massachusetts (DPW), Connecticut, California, Washington and Colorado are closely related to the guidelines for Type I projects. As of this writing, no other New England states (beyond Mass. and Conn.) have formally adopted policies for a Type II noise program.

TABLE 1

FEDERAL HIGHWAY ADMINISTRATION
NOISE ABATEMENT CRITERIA

(Hourly A-Weighted Sound Levels - Decibels [dBA]*)

Activity Category	Leq(h)**	Description of Activity
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	___	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

* Noise is measured in "decibels" (dB), a numerical expression of sound levels on a logarithmic scale. An "A"-Weighted decibel (dBA) filters out the high and low pitches inaudible to the human ear.

** Leq: The equivalent steady-state sound level which in a stated period of time contains the same acoustical energy as the time-varying sound level during the same period. Leq(h) is the hourly value of Leq.

Source: 23CFR772 - Procedures for Abatement of Highway Traffic Noise and Construction Noise.

TABLE 2

REPRESENTATIVE STATE NOISE ABATEMENT POLICIES AND GUIDELINES FOR TYPE I AND TYPE II PROJECTS

JANUARY, 1990

	MASS (DPW)	CONNECTICUT	VIRGINIA	NEW JERSEY	NEW YORK	MARYLAND	PA
Residential (exterior) Noise Abatement Criterion	67 dBA, Leq or more	67 dbA, Leq or more	67 dbA, Leq or more	64 dbA, Leq or more	67 dbA, Leq or more	67 dbA, Leq or more	66 dbA, Leq or more
Substantial Increase in existing noise level	10 dB or more	15 dB or more	10 dB or more	10 dB or more	6 dB or more	10 dB or more	10 dB to 15 dB depending on existing level
Minimum noise reduction considered to be effective	10 dB	7 dB	5 dB	5 dB for design 3 dB for C/E counts	5 dB (must be assoc. w/7 dB + @ other receivers)	5 dB	5 dB
Guidelines for reasonable cost per dwelling unit	$2400/dB NR/ dwelling	None	$20,000 published	No Published Value	No Published Value	No Published Value	No Published Value
Barrier cost assumed for cost-effectiveness calcs:	$14/sf concrete & wood $17/sf steel & on structure	N/A	$16/sf	$20/sf	$15 to $25/sf	$27/sf ("all-inclusive")	$20 to $25/sf
Dwelling unit counts as protected if barrier provides minimum NR but Leq doesn't exceed NAC?	Yes	N/A	No	Yes 1/2 Weighting	Yes	No	N/A
Formal Type II Program?	Yes	Yes	No	Yes	No	Yes	No
Differences in policy for Type II Study?	No	Less Liberal With Funds	N/A	No	N/A	No	N/A

TABLE 2 Continued

REPRESENTATIVE STATE NOISE ABATEMENT POLICIES AND GUIDELINES FOR TYPE I AND TYPE II PROJECTS

JANUARY, 1990

	UTAH	CALIFORNIA	WASHINGTON	COLORADO
Residential (exterior) Noise Abatement Criterion	67 dbA, Leq or more	67 dbA, Leq or more	67 dbA, Leq or more	67 dbA, Leq or more
Substantial Increase in existing noise level	10 dB or more	12 dB	10 dB or more	10 dB or more
Minimum noise reduction considered to be effective	5 dB for design 3 dB for C/E counts	5 dB	N/A	N/A
Gudelines for reasonable cost per dwelling unit	$12,000 Published	$30,000 Published	No Published Value	No Published Value
Barrier cost assumed for cost-effectiveness calcs:	Not Available	Not Available	$ 11/sf	$4 to $ 7/sf
Dwelling unit counts as protected if barrier provides minimum NR but Leq doesn't exceed NAC?	Yes	N/A	N/A	N/A
Formal Type II Program?	No	Yes	Yes	Yes
Differences in policy for Type II Study?	N/A	Must be Within Qualifying Area	No	No

In addition, fifteen turnpike and tollroad authorities were contacted to determine their present involvement in noise abatement projects. These authorities and their noise abatement policies are listed in Table 3. Currently, only New York and Virginia have adopted noise abatement policies. Both authorities follow policies similar to their respective DOTs. Illinois and New Jersey authorities have built noise barriers as part of new construction or widening projects, but have no formal policies or programs.

TABLE 3
NOISE ABATEMENT POLICIES OF
OTHER TOLL ROAD AUTHORITIES

Kentucky	-	No Barrier Policies
Illinois	-	No Barrier Policies
Maine	-	No Barrier Policies
New Hampshire	-	No Barrier Policies
New York	-	Has Type II Policy
New Jersey	-	No Barrier Policies
Pennsylvania	-	No Barrier Policies
Maryland	-	No Barrier Policies
Ohio	-	No Barrier Policies
Virginia	-	Follows VADOT
Indiana	-	No Barrier Policies
Kansas	-	No Barrier Policies
Oklahoma	-	No Barrier Policies
Florida	-	No Barrier Policies
Texas	-	No Barrier Policies: May adopt DOT process currently being developed.

2.3 Role of Local Governments and Officials

One of the important goals of a systemwide noise abatement program is to provide information to local governments and officials in order to prevent future traffic noise impacts on currently undeveloped lands within whose jurisdiction the Turnpike is located. Such information would be useful to local communities to protect future land development from becoming incompatible with anticipated highway noise levels. With this information, local governments could then exercise their powers and responsibility to minimize the effect of traffic noise through appropriate land use control, including efforts to control development by the adoption of land use plans and zoning, subdivision, building, and housing regulations.

It is intended that all eligible noise-sensitive land uses currently in place and occupied would be considered in the pilot Type II Noise Abatement Program. However, by adoption of such a Program, the Authority would notify communities that consideration would not be given to developments occupied subsequent to the adoption and public notification of the Massachusetts Turnpike Authority's Type II Noise Abatement Program.

3.0 FORMATION OF A TYPE II NOISE ABATEMENT POLICY

The objective of this section is to consider and formulate the actual Turnpike policy for Type II noise abatement. The eligibility requirements set forth in Section 3.1 below were developed from the eligibility requirements of the Massachusetts Department of Public Works (MDPW). The factors important to the development of a priority ranking system, as presented in Section 3.2, are intended to serve as guidelines for the subsequent adoption of a priority ranking system through the completion of acoustical studies.

The eligibility policy of the pilot Type II program focuses on assessing noise abatement for activities associated with residential and public facility land uses. Land uses of these types adjacent to both the mainline Turnpike and Interchange areas would be considered. Consideration of other category B and E activities (See Table 1) may be considered in the future.

3.1 Eligibility Requirements

An area or site must meet the following criteria to be eligible in a Type II Program:

1) Noise impacted, ground level sensitive receptors must be determined to be immediately adjacent to the Turnpike and include single and multi-family residences and publicly-owned facilities;

2) There must be an existing noise impact defined by a minimum Leq(h) of 67 dBA at the edge of the right-of-way, with abutting property of the sensitive receptors, as determined by computed noise levels.

3) Projected noise level reduction must be a minimum of 10 dBA;

4) There must be economic reasonableness and physical feasibility of mitigation measures;

5) Funding availability;

6) The site must be on the Final Priority List;

All sites identified on the priority list for receiving a noise barrier would be required to meet a cost-effectiveness criterion established as part of the pilot Type II noise barrier program. Cost-effectiveness is defined in terms of cost per decibel reduction per unit protected by the noise barrier. The number of units protected includes all residences and publicly-owned facilities that would receive at least the minimum specified noise reduction achieved as a result of the noise barrier construction. Mitigation measures may be considered cost-effective if the cost does not exceed $2400/dB reduction/unit.

3.2 Factors Involved in the Development of a Priority Ranking System

The implementation of a priority ranking system provides sensitive land uses adjacent to the Turnpike a realistic sense of where they fall with respect to other sensitive uses in need of noise barriers. The criteria developed for the

pilot Type II program would be used in conjunction with other factors important to the Massachusetts Turnpike Authority, to develop and implement a system of priorities for ranking the need for installation of noise barriers at the highest impact areas along the Turnpike.

One such factor important to the Authority is the consideration of the different regional characters occurring over the length of the Turnpike. Over its 135 mile length, the Turnpike passes through urban, suburban and rural regions. In developing a priority ranking system, the Authority will consider establishing priority ranking for each regional character.

Seven state highway departments have established a ranking methodology. These methodologies were examined in terms of mathematical formulation and dependent variables. Based upon this review, the following variables were considered as important ranking factors by the highway departments:

- Leq noise level

    Duration of Leq noise level
    Traffic

- Age of residential unit

    Construction before or after turnpike

- Cost of noise barrier

- Number of units receiving abatement

- Barrier insertion loss or achievable reduction

Field insertion loss could be dropped from consideration as a dependent variable because each barrier would be designed to provide a minimum insertion loss of 10 dB.

In order to recommend a ranking method, the limitations and/or inconsistencies of other known methods would be reviewed by the accoustical consultant. The majority of the state highway department's equations do not equally weight each parameter. In fact, two of the departments square the first factor in their equations, $(\text{Predicted Leq noise level - the NAC of 67 dBA Leq})^2$. Squaring this factor applies an exponential weighting to the predicted Leq values. This means that a ten (10) decibel increase in noise level, a doubling of the annoyance level, amounts to a 100-fold increase in a barrier's ranking for all other parameters held constant. In addition, these same equations are represented as a product of various terms, different terms that sum to the same quantity will not yield the same product. This is best explained by an example.

Assume Case 1 and Case 2 are two independent rankings with the parameter values of A and B.

	Parameter A	Parameter B	A + B	A X B
Case 1	100	50	150	5000
Case 2	125	25	150	3125

As indicated, an arithmetic ranking would yield the same value of 150 for each case. However, a geometric or product method would give a higher ranking to Case 1 for no apparent reason. From this example it is clear that a geometric weighting is inconsistent. The product method yields a 60% increase in ranking of Case 1 over Case 2. In fact, if Parameter A approached 150 and Parameter B approached zero, the ratio of products (Case 1 / Case 2) would approach infinity.

A ranking methodology that avoids the situation created above is one that sums all the parameters and treats them all equally. An example of this is the following methodology using four parameters; the noise level factor, the traffic factor, the age factor and the cost per dwelling unit factor. The noise level factor, NL, could be expressed as

$$NL = \sum_{i=1}^{N} [(NLi - NAC) \times Di] / \sum_{i=1}^{N} Di \qquad [1]$$

where NLi is the unabated Leq noise level modeled by STAMINA 2.0, NAC is the FHWA NAC, and D is the number of dwelling units that are representative of the predicted noise level at location "i".

The traffic factor, TF, could be expressed as

$$TF = ADT/24 \times LOS\ C \qquad [2]$$

where ADT is the average daily traffic and LOS C is the LOS C traffic volume for each Turnpike segment. The traffic factor (TF) is used to account for the duration of noise exposure at various locations along the Turnpike for a 24-hour period as a function of average daily traffic and the LOS C capacity of the Turnpike. The TF is developed so that if a Turnpike segment operated at optimum volume and speed for an entire day, every day of the year, the TF would be equal to one.

The age factor, AF, is derived to include the relative age of each impacted community, to the oldest segment of the Turnpike and it's age relative to the abutting Turnpike. AF could be expressed as

$$AF = [(SY - TPY) + (SY - CY)] / [2 \times (SY - OTY)] \qquad [3]$$

where,

SY = Study year (1990)

TPY = Opening year of abutting turnpike

CY = Year residential development was platted or date of construction of receptor

OTY = Opening year of oldest turnpike

The AF accounts for the different ages of the various communities by giving a heavier weighting to the oldest residential areas and less weighting to the most recent developments. A residential receptor would have an AF of 1 if the receptor predated and was adjacent to the oldest turnpike segment.

Since Equation [3] is designed to provide a maximum value of one and is not intended to provide any additional weighting for receptors that existed prior to the development of the turnpike, the construction date of any residential receptor that predated the abutting turnpike automatically defaults to the construction date of the abutting turnpike.

The final factor to consider, CD, is the cost per dwelling unit factor which could be expressed as

$$CD = BC/D \qquad [4]$$

where BC represents the barrier cost and D represents the total number of ground floor dwelling units adjacent to the barrier receiving 10 decibels or more of attenuation. All ground floor residential living units that are either first row units or have line of site to the abutting turnpike should be included in the number of units adjacent to the noise barrier. The number of units would be determined as follows:

- o Single family - 1 unit
- o Town house (Side by side) - 2 units
- o Duplex - 1 unit
- o Apartment complexes - 1 unit per first floor apartment
- o Condominium developments - Same criteria as Apartment Complexes

Once the factors for each barrier are determined, the values are linearly normalized to values between zero (0) and one (1) with the highest NL being assigned a value of one (1) and the lowest NL a value of zero (0). The highest TF is assigned a value of one (1) and the lowest a value of zero (0). As with the NL and TF, when the AF is normalized the highest AF is assigned a value of one (1) and the lowest a value of (0). The CD order is reversed with lowest CD assigned a value of one (1) and the highest a value of zero (0). The normalized factors are referred to as F1, F2, F3, and F4 representing the normalized factors for noise level, traffic, age and cost per dwelling respectively.

The equally-weighted priority rating factor, EWF, is then given as the summation of these individual terms

$$EWF = F1 + F2 + F3 + F4 \qquad [5]$$

with

$$0 \leq F1 \leq 1$$

$$0 \leq F2 \leq 1$$

$$0 \leq F3 \leq 1$$

$$0 \leq F4 \leq 1$$

such that Equation [5] EWF can only take on values between 0 and 4, with the latter being the highest priority ranking. In addition, each of the parameters that comprise Equation [5] carry equal weighting.

4.0 SCOPE OF WORK AND COST ESTIMATE FOR DEVELOPMENT OF THE FINAL PRIORITY LIST

Development of the Final Priority List, including acoustical studies, would be performed by an acoustical consultant. The general scope of work for subsequent phases of the Type II program development is discussed below.

4.1 Scope of Work

The scope of work for effectuating the study has been assumed to consist of the following tasks:

STEP 2:

- o Compile available mapping, plans, etc., traffic data, and land use information;
- o Review known problem sites and recent aerial photogrammetry to identify new construction or demolition of sensitive receptors.
- o Complete a field reconnaissance to positively identify receptors, rule out areas where mitigation is obviously infeasible and to verify map data;
- o PRODUCT: Tabulation of eligible noise sensitive land uses within 500 feet of the Turnpike shoulder.

STEP 3:

- o Conduct noise measurements at right-of-way lines and simultaneous traffic counts (to be used for noise model validation and for peak hour noise prediction). Obtain common (or similar in scale) mapping from each town with a site in the study group;
- o Compute existing peak noise levels for noise sensitive land uses identified in Step 2;
- o PRODUCT: Computed peak noise levels at the right-of-way line adjacent to identified sensitive receptors.

STEP 4:

- o Determine preliminary barrier design (length and height) necessary for significant insertion loss for impacted, noise sensitive land uses;
- o Determine physical feasibility and approximate cost of barriers;
- o Determine attainable insertion loss;
- o PRODUCT: Tabulation of barrier dimensions, insertion loss, number of units protected, approximate barrier costs and cost/decibel reduction/unit value.

STEP 5:

- Establish a procedure for ranking eligible sites;
- Rank sites according to established procedures;
- Prepare a technical report detailing the Priority Ranking Study;
- PRODUCT: Technical Report including the Final Priority List

4.2 Cost Estimate

This section presents an approximate cost for completing Steps 2 through 5 of the Type II Program. The cost considers the effort necessary to perform the scope of work outlined above.

For the purpose of this study, it was assumed that approximately 115 sites would be evaluated and ranked. This was based upon a review of USGS maps which are standardized for all communities. A site was identified for ranking if at least one receptor existed within 500 feet of the Turnpike shoulder.

Based on the assumption that 115 sites are to be evaluated and ranked, the approximate order of magnitude cost estimate for an acoustical consultant to perform the scope of work presented above is $400,000.

5.0 CONSIDERATIONS RELATED TO DESIGN

Specific design considerations related to the construction (Step 6) of noise barriers, including design and materials, aesthetics, maintenance, and environmental impacts, are discussed below. Community involvement, a critical element in the design process, would be incorporated throughout design.

5.1 Design and Materials

Noise barrier location within the right-of-way, barrier height, and barrier length comprise the three basic physical dimensions of the barrier which affect its attenuation.

The location of the noise barrier within the right-of-way varies depending on topography and right-of-way clearances. The most desirable location for a noise barrier is either just inside the right-of-way, or at least 30 feet or more from the edge of the travel lane. The 30 foot dimension represents the roadway clear zone. Should it become necessary to place the noise barrier within 15 feet of the edge of travel lane, the noise barrier should be mounted on top of, or immediately behind, a safety-shaped concrete barrier. Between 15 to 30 feet from the edge of the travel lane, guardrails or the safety-shaped concrete barrier should be considered in conjunction with the noise barrier. No barrier should be placed within 10 feet of the edge of travel lane. Should the noise barrier be placed just inside the right-of-way, enough space should be provided behind to barrier so as to be accessible for maintenance. Figure 1 presents typical sections for alternate noise barrier locations within the right-of-way.

An additional consideration with respect to barrier location involves maintaining adequate sight distances. This is a particular concern for barriers located on the edge of the shoulder along the inside of a curve, or barriers located in the vicinity of on- and off-ramps, ramp intersections, and intersecting roadways. Location of a noise barrier should be located such that sight distance standards are maintained (See Figure 1).

Noise barrier wall height varies depending upon its location within the right-of-way, topographic considerations, and targeted noise reduction. Barrier height is measured from finished ground surface to top of barrier. When barriers are mounted on concrete safety shapes, barrier height is measured from pavement surface to the top of barrier. Barrier heights typically range from 10-24 feet.

Noise barriers can be constructed of a variety of materials including wood, precast concrete panels, masonry block, earth berm, metal, and plastic. Figure 2 shows examples of some of these materials for noise barriers along existing highways. The majority of these materials can be used to provide the minimum targeted noise reduction. Typically, the choice of noise barrier material is dependent upon regional economics and local preferences. However, transportation and placement of materials must also be considered when selecting the type of noise barrier to construct. Consideration of material

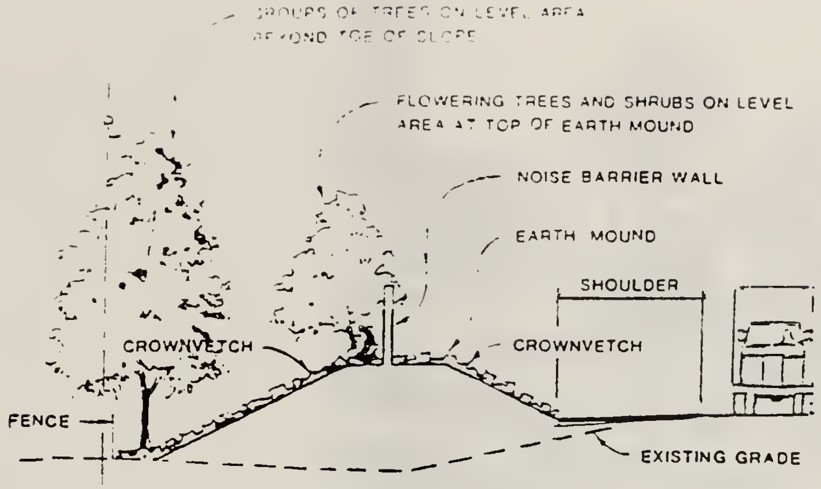

GROUPS OF TREES ON LEVEL AREA BEYOND TOE OF SLOPE
FLOWERING TREES AND SHRUBS ON LEVEL AREA AT TOP OF EARTH MOUND
NOISE BARRIER WALL
EARTH MOUND
SHOULDER
CROWNVETCH
CROWNVETCH
FENCE
EXISTING GRADE

FIGURE 1A. TYPICAL SECTION - NOISE BARRIER ON EARTH BERM

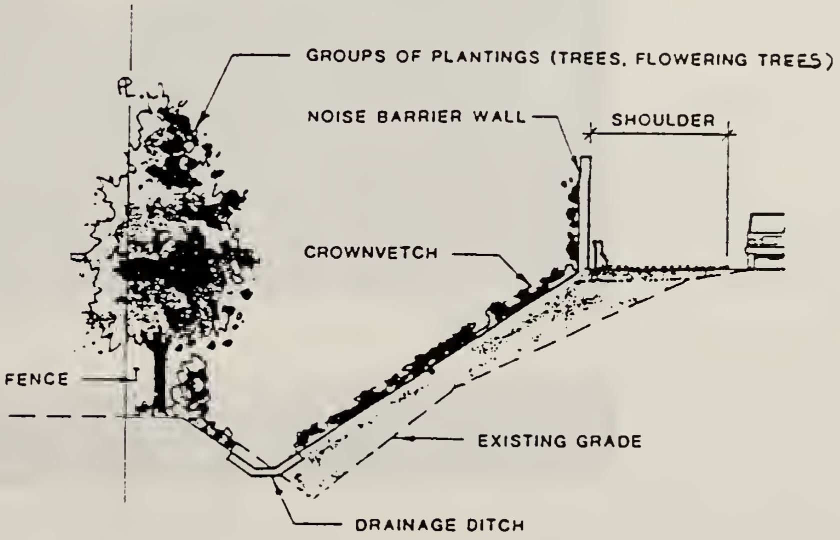


FIGURE 1B. TYPICAL SECTION - NOISE BARRIER ADJACENT TO SHOULDER

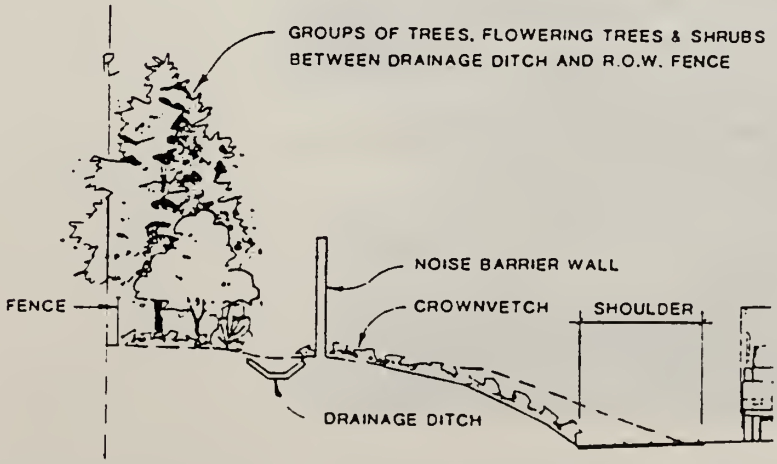
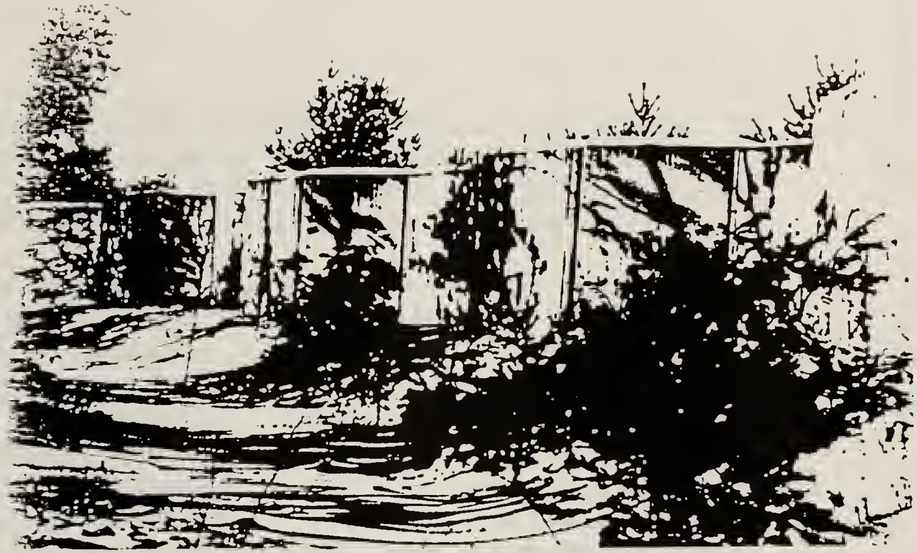

GROUPS OF TREES, FLOWERING TREES & SHRUBS BETWEEN DRAINAGE DITCH AND R.O.W. FENCE
℄
NOISE BARRIER WALL
FENCE
CROWNVETCH
SHOULDER
DRAINAGE DITCH

FIGURE 1C. TYPICAL SECTION - NOISE BARRIER AWAY FROM TRAVEL LANE

FIGURE 1. ALTERNATE NOISE BARRIER LOCATIONS WITHIN RIGHT-OF-WAY



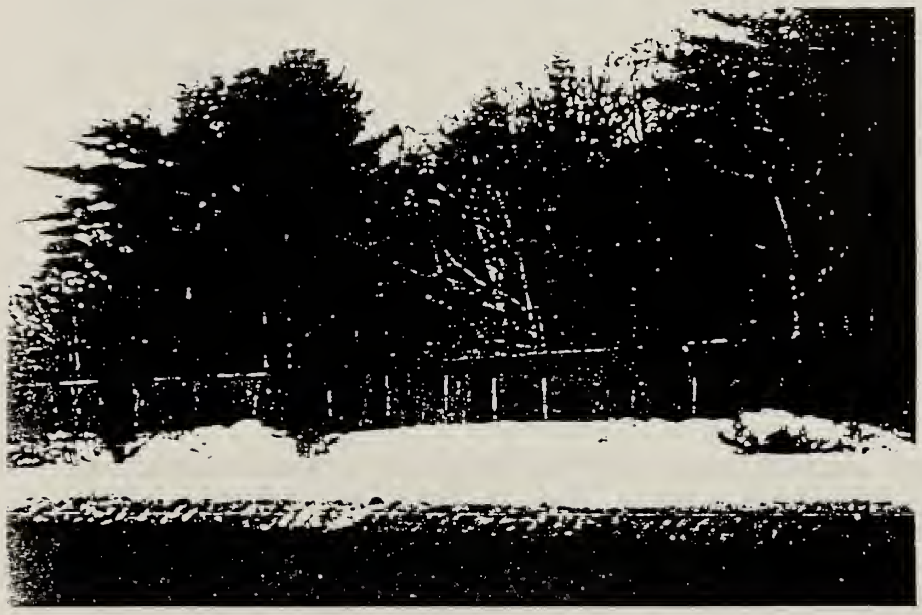


FIGURE 2B.
WOOD
INTERSTATE 95 (NORTHBOUND)
TOPSFIELD, MA

FIGURE 2C.
EARTH BERM
INTERSTATE 9[illegible] (WESTBOUND)
FRAMINGHAM, MA

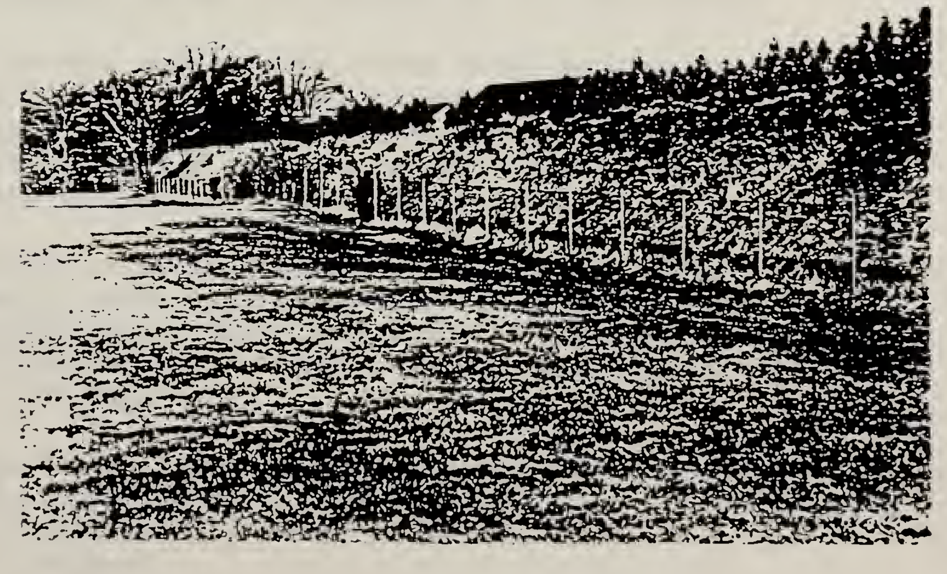


FIGURE 2. STANDARD NOISE BARRIER MATERIALS IN USE ALONG EXISTING HIGHWAYS

must also be made when installing barriers in areas of steep right-of-way, in areas of overhead wires and trees, or in areas of underground utilities and extensive tree root systems. For example, precast panels may not be feasible in some areas since placement of panels by crane may not be possible.

Community meetings would be held throughout the design process. Residents adjacent to the Turnpike would thereby have a forum in which to participate in the design process. The community should be informed of the noise measurements, methodology, and priority list which were used to determine that their community is in need of a noise barrier. Based on this information, the community could provide input regarding materials and placement of the barrier with respect to their property. Some communities may, by consensus, decide that they do not want to receive a noise barrier, and that the lower sight barriers may be more appropriate. Community concerns must be factored into final design.

5.2 Aesthetics

The visual impact of the noise barrier to adjacent residences and travelers of the Turnpike is another major design consideration. Two basic design goals for noise barriers include the following:

(1) Relate barrier materials to the existing environment by continuing existing color, material and texture treatments where possible, and

(2) Minimize the visual dominance of the noise barrier in relation to the existing environment.

Aesthetics related to noise barrier installation includes aesthetic treatment of the material selected as well as providing additional landscaping along the length of barrier wall.

Visually-pleasing barriers can be achieved through variations in wall type, form, and surface treatment. Table 4 identifies various treatments available for several noise barrier materials. Generally, the most desirable visual treatment of barrier walls is through the use of landscaping and earth berms.

Plantings consisting of trees, shrubs, and climbing vines could be used in addition to earth berms, to provide visually pleasing views to both the adjacent community and the drivers of the Turnpike. Care should be taken in the selection of planting materials located adjacent to the roadway such that they are resistant to the effects of salt and other roadway runoff.

Particular consideration, from both an aesthetic and safety point of view, should be given in the area where a noise barrier terminates. A combination of landscaping and stepping or sloping of a barrier wall could be provided so as to provide a visual transition from the noise barrier, to the existing roadway landscaping beyond the barrier (See Figure 2).

The community should be involved in the decision regarding surface treatment of the material decided upon for the noise barrier. The community should also provide input as to the type of landscaping desired, particularly in areas that are adjacent to (or abut) their property.

TABLE 4

VARIOUS TYPE AND SURFACE TREATMENTS OF NOISE BARRIER MATERIALS

Material	Type	Surface Treatment
Wood	Post and Plank Post and Panel	Paint Stain
Concrete	Precast Panels Cast-in-Place	Form Liner Finish Exposed Aggregate Sandblast Integral Color Stain
Masonry	6" Slump 4" Slump Split Face	Integral Color Paint
Metal	Sheet Metal Panel Weathering Steel	Colored TEDLAR None
Earth Berm	3:1 Slope 4:1 Slope	Landscape

5.3 Maintenance

Maintenance is another factor which must be considered in the design of noise barriers. Maintenance refers to preservation and upkeep of the noise barrier itself, maintenance associated with adjoining landscaping, and replacement of materials damaged by impact (should the barrier be placed within the clear zone).

As previously mentioned, barriers should be located such that all maintenance activities can be performed within the Turnpike property limits. Additionally, for long lengths of barrier walls when access is not available via local streets, access doors or passageways should be provided at satisfactory intervals along the barrier wall in order to provide adequate maintenance.

Use of different materials provide for different maintenance considerations. Noise barrier materials selected should be appropriate for the environment in which they are placed. In locations of possible impact, concrete noise barriers are desirable.

Precast concrete panels and concrete block walls are considered to be relatively maintenance free for up to approximately 50 years, not taking into account potential damage due to collision. Wood, steel, and other surfaces are generally more costly to maintain than unpainted concrete surfaces. However, graffiti is a maintenance problem which, for concrete walls, would require sandblasting. Maintenance should be considered in the choice of noise barrier material.

Maintenance agreements with abutting communities may have to be considered for the area between the noise barrier and the abutting community. Maintenance considerations should be discussed as part of the community process.

5.4 Environmental Impacts

Noise barriers constructed along the Turnpike should be designed so as to minimize impacts to the existing environment. Disturbance of wetlands adjacent to the Turnpike in order to construct noise barriers should be avoided. In areas where construction of a noise barrier would impact wetlands, alternate means of noise abatement should be considered.

Consistent with the Massachusetts Environmental Protection Act (MEPA), administered by the Executive Office of Environmental Affairs (EOEA) MEPA Unit, construction of noise barriers with costs greater than $1,000,000, including the cost of design, would require the filing of an Environmental Notification Form (ENF) with the EOEA. A determination would then be made by the EOEA regarding the preparation of an EIR. A barrier wall of approximately 2500 feet in length or longer would most likely require the filing of an ENF.

Consistent with the Wetlands Protection Act, administered by the Massachusetts Department of Environmental Protection (DEP), construction of noise barriers located within 100 feet of wetlands, waterways, water bodies or floodplains would require filing of a Notice of Intent with the local Conversation Commission. An Order of Conditions would also need to be obtained from the local Conservation Commissions.

Public hearings are required as part of the review process when filing either the ENF or NOI.

5.5 Scope of Work for Design Services

The location of the noise barrier within the right-of-way, the barrier height, barrier length, and the type of material to be used would be determined by the Authority in close consultation with the acoustical consultant. For the purpose of this study, the scope of work for acoustical design services has been assumed to consist of the following tasks: advise the Authority throughout the development of a final policy statement; obtain detailed mapping of the design area; recommend the location, length, and height of barrier wall; recommend the type of material of barrier wall; attend meetings with the Authority; and conduct community meetings.

For the purpose of this study, the scope of work for engineering design services, to be performed in conjunction with acoustical design, has been assumed to include the following tasks: conduct geotechnical subsurface investigation; locate overhead and underground utilities; review existing drainage and modify, as required; recommend the specific architectural treatment of the barrier walls; perform structural design for two alternate barrier wall materials and corresponding foundations; develop landscaping alternatives; prepare plans, specifications, and final construction cost estimate; attend meetings with the Authority and community.

Sources:

1. 23 CFR Part 772 - Procedures for Abatement of Highway Traffic Noise and Construction Noise.
2. Noise Barrier Design Handbook, FHWA-RD-76-58, Feb. 1976.
3. State of California Department of Transportation Highway Design Manual - Chapter 1100, Highway Traffic Noise Abatement, January, 1987.
4. State of Massachusetts (DPW) Noise Attenuation Study, March, 1988.